DESIGN OF A WATER SUPPLY SYSTEM FOR SARAWAK NATIONAL YOUTH TRAINING INSTITUTE

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Form of Acceptance

This project report entitled "Design of A Water Supply System for Sarawak National Youth Training Institute" was written by Tay Guan Heng as a partial fulfillment for the degree of Bachelor of Engineering (Hons) Civil Engineering in Unimas is accepted and certified by:

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Design of A Water Supply System for Sarawak National Youth Training Institute

Written by,

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A proposed design project report submitted in partial fulfillment for degree of Bachelor of Engineering (Hons) Civil Engineering in University Malaysia Sarawak

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Abstract

This dissertation describes the design of a water supply system for Sarawak National Youth Training Institute, Miri by the combination of pump-gravity flow system. The procedures of design follow the criteria from JKR Malaysia standard, edition 1989. However, the standard itself is not quite detailed in certain aspects. For the analysis, a computer program, Water CAD (student edition), developed by Haestad's company was used to solve the network system. In the analysis, several load cases were analyzed in order to see the variation of flow rate and residual pressure in responding to different load cases, so that the pipe sizes and elevation of high level tank can be determined to suite the minimum requirements of standard.

Abstrak

Tesis ini memperihalkan tentang rekabentuk sebuah sistem hantaran air bagi Institut Kemahiran Belia Negara Sarawak, Miri menerusi kombinasi sistem pam dan graviti. Prosedur-prosedur dalam merekabentuk sistem hantaran air ini adalah dirujuk dari standard JKR Malaysia, edisi 1989. Namun, masih terdapat kekurangan dalam standard tersebut kerana tidak menerangkan secara lebih mendalam aspek-aspek tertentu. Bagi memudahkan analisis, suatu komputer program iaitu Water Cad (edisi pelajar) yang direka oleh syarikat Haestad telah digunakan untuk menyelesaikan masalah kiraan. Dalam analisis tersebut, beberapa kes-kes kajian telah dilakukan untuk melihat sejauh manakah variasi kadar aliran air dan baki tekanan yang tinggal supaya saiz pipe dan ketinggian tangki atas boleh ditentukan bagi memenuhi kehendak JKR.

Chapter one:

Introduction

1.0 Project Background

The Sarawak National Youth Training Institute project was proposed in the early year of 1998 and is scheduled to be completed in the end of August 2002 with a total cost estimated RM54 million. The client and other parties involved in this project are:

Client
Ministry of Youth and Sport

Architect
Arkitek Nur Cipta Snd. Bhd.

M&E
Ranhill Bersekutu (Sarawak) Sdn. Bhd.

Quantity Surveyor
Kumpulan Ukur Bahan Sarawak

Civil Engineering and Structure
PU Engineering Sdn. Bhd.

1.1 Site Background

The proposed site is situated near Riam road, 7km away from Miri City and covers 64 acres, figure 1.

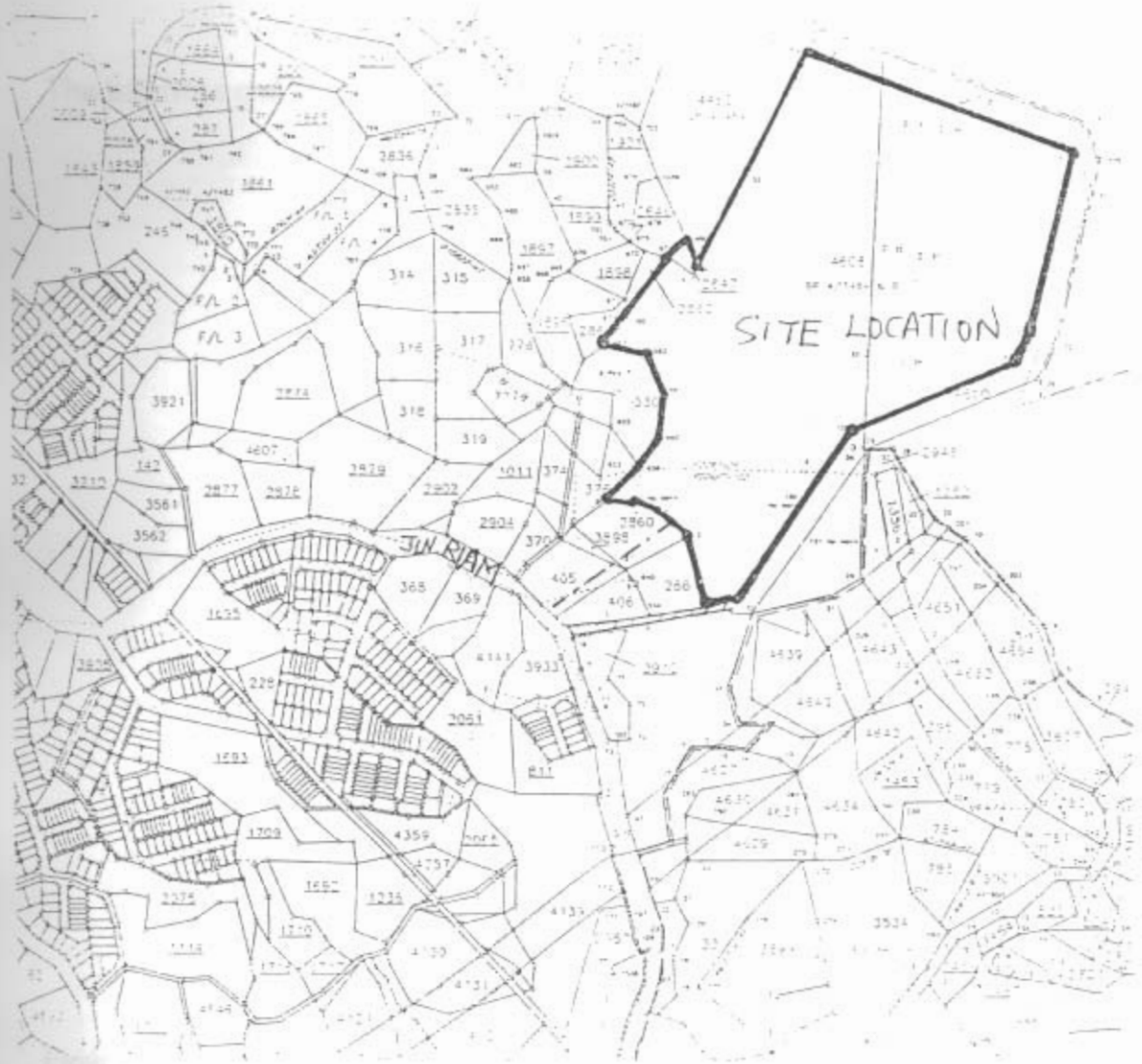

Figure 1: Locality Diagram

Scale: 1 : 10000

Legend

Proposed temporary access road to the site

Existing (Laku) water line

1.2 Buildings and Facilities Provided

The buildings and facilities provided in the institute are:

No	Buildings and facilities	Unit
1	Administration Building	1
2	Hospitality Workshops	1
3	Automotive Workshops	1
4	Mechanical Workshops	1
5	Multi-purpose Hall	1
6	Hostel	4
7	Dining Hall	1
8	Surau	1
9	Quarters	4

Table 1: Types of Buildings and Facilities Provided

Figure 2 shows the detailed buildings and facilities provided in the institute.

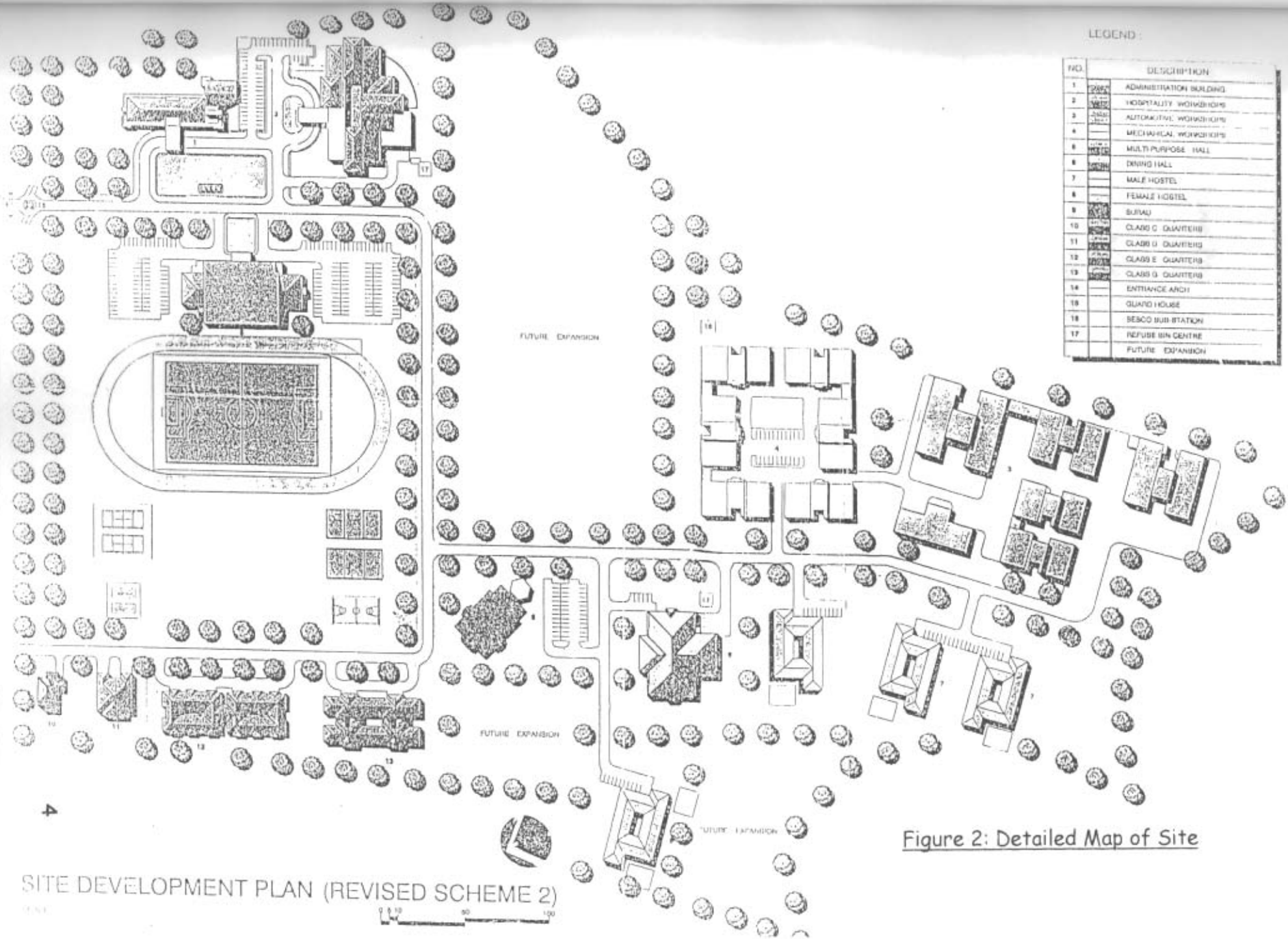

Figure 2: Detailed Map of Site

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1.3 Intake Population

The total projected population of the institute for the beginning is 1210. 900 will be students and the rests are teachers, staffs and their families.

1.4 Source of Water Supply

The source of water supply to the institute is supplied from existing Laku water line. This connection is shown in figure 1 in section 1.1.

1.5 Objective of Proposed Design

The aim of this project is to deliver water to individual consumers in the required quantity and under a satisfactory pressure.

Chapter 2:

Water Demand

2.0 Water Demand Forecasting

Various factors including unsatisfied demand, unaccounted water loss and future expansion of population shall be considered in design. The basic formula used to estimate water demand for storage purpose is as follows:

$$W = P_n \times C \times F \times M_d + D_a$$

Where W = water demand at the end of year "n"

P_n = population projection at the end of year "n"

C = per capital consumption at the end of year "n"

F = service factor at the end of year "n"

D_a = additional water demand at the end of year "n"

M_d = maximum daily factor

2.1 Population Projection

Population projection for an institutional area is quite different from other kind of areas because of fixed boundary and facilities provided. Therefore, an ultimate population of 1800 is projected throughout the design period. This extra addition of 590 people is based on the future

addition of two hostels and educational facilities which can accommodate 450 students and 140 teachers and staffs.

2.2 Per Capita Consumption

Referring to the guideline given by JKR, shown in table 2, the per capita consumption for related category is 230 liters / head / day. This consumption rate had taken into consideration of unaccounted water losses demand. Hence, extra water demand for unaccounted water losses shall not be included again as it might affect the total storage of water. Normally, the per capita consumption shall be increased at 5 year intervals until year 20 and the target to set for year 20 will depend on the projected size of the institutional area. Due to the fixed boundary of the institute, the increase of per capita consumption can be ignored.

Categories	Per Capita Consumption
Urban	230 to 320 liters / head / day
Semi-urban	180 to 230 liters / head / day
Rural	135 to 180 liters / head / day

Table 2: Range of Per Capita Consumption for Each Category

2.3 Service Factor

Service factor is the potential percentage of population will be served in the area. Since 100% of population is being served, a service factor of 1 is selected.

2.4 Provision for Additional Water Demand

The extra water demand is provided as deem to cater for fire fighting purpose. From table 3, outlined in JKR standard, the required water demand is 2700 liters per minute under class B risk with two hydrant outlets are allowed to use simultaneously. For fire fighting requirement, it is recommended that the water will only discharge for an hour duration. Otherwise, a large quantity of water will be needed to be stored. This can cause an over burden to structures especially for high level tank where the cost of reinforcement to the structures to withstand a high loading from above will be very high, which is not economical.

Category	Average total flow (l / min)	Spanning (m)	Maximum no. of hydrant outlets used simultaneously
Class A Risk Large buildings, shopping complexes, high rise buildings, large industrial estate, warehouse and ports.	4100	90	3 @ 1370 l/min
Class B Risk Congested areas with buildings up to 5 story.	2700	90	2 @ 1370 l/min
Class C Risk Shop house up to 3 story, light industry.	1370	90	1 @ 1370 l/min
Class D Risk Residential terrace house, detached, semi detached.	1140	120-terrace 150-detached/ semi detached	1 @ 1370 l/min
Class E Risk Others	680	180	1 @ 1370 l/min

Table 3: Fire Flow Requirements

2.5 Maximum Daily Factor

This provision for maximum daily factor is not clearly stated in JKR Malaysia standard. This maximum daily factor is mainly given for storage purposes and is considered here because of possibility unexpected critical loading might happen. Generally, water usage in an institute can be affected by climate variation such as hot season and rainy season; annual activities organized like open's day and sport's day. Without considering the cases, the design will not be satisfactory. According to standard made by JKR Sarawak, edition 1986, the maximum daily factor is 1.10.

2.6 Demand Calculation

From above formula given in section 2.0, total water demand needed for one day storage will be:

W = Peak users demand x peak daily factor + fire demand

= 1800 x 0.23 x 1x 1.1 + 162

= 455 + 162

= 617 m^3

≈ 620 m^3

Chapter 3:

Distribution System

3.0 Distribution System Design

The system used here is a combination of pump-gravity distribution system. That is the action of gravity is used to move the water downward from elevated tank and pump is used to deliver water into elevated tank, figure 3:

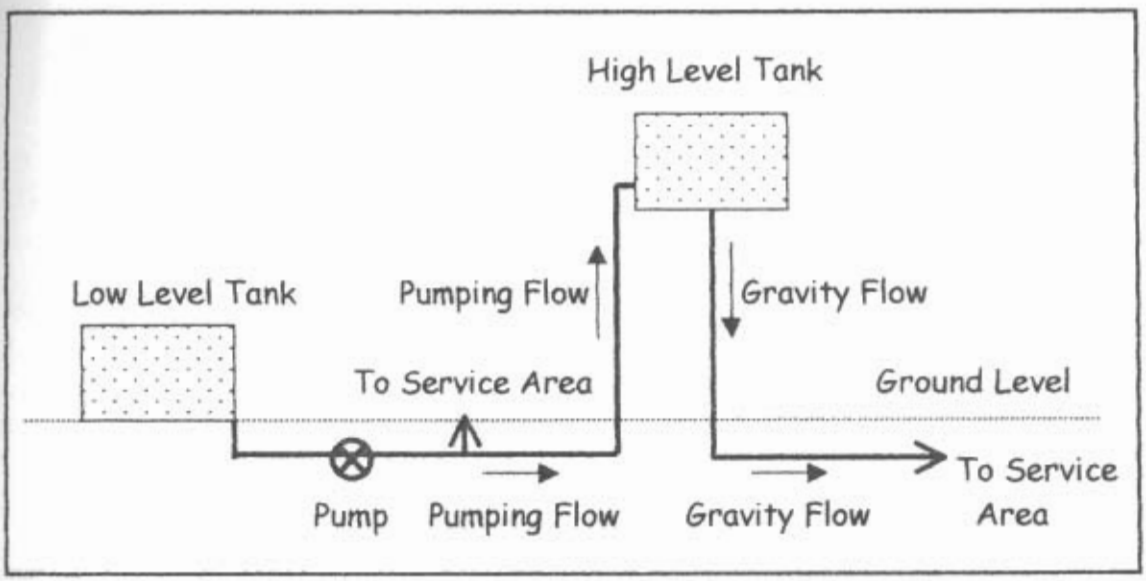

Figure 3: A Combination of Pump-gravity Distribution System

Generally, water distribution system can be divided into three major components such as pumping station, distribution storage and distribution network.

3.1 Pumping Station

The pumping station is placed in the delivery section of low level tank.

3.1.1 Pump Design

The design of pump is focused on design head and discharge. In the analysis, both the design head and discharge are specified. For the specified head and discharge, the analysis is being carried out to examine whether the pump has sufficient power to deliver water into high level tank.

3.1.2 Purpose of Pump

The function of the pump is to deliver water to high level tank. The pump is designed to switch on automatically when the storage level in high level tank has reached the defined critical level and supply water until it reaches the desirable storage level. Then, the pump will automatically switch off. The critical storage level is 2m from tank base level and desirable storage level is 4.13m. The detailed layout of pumping station is shown in figure 4.

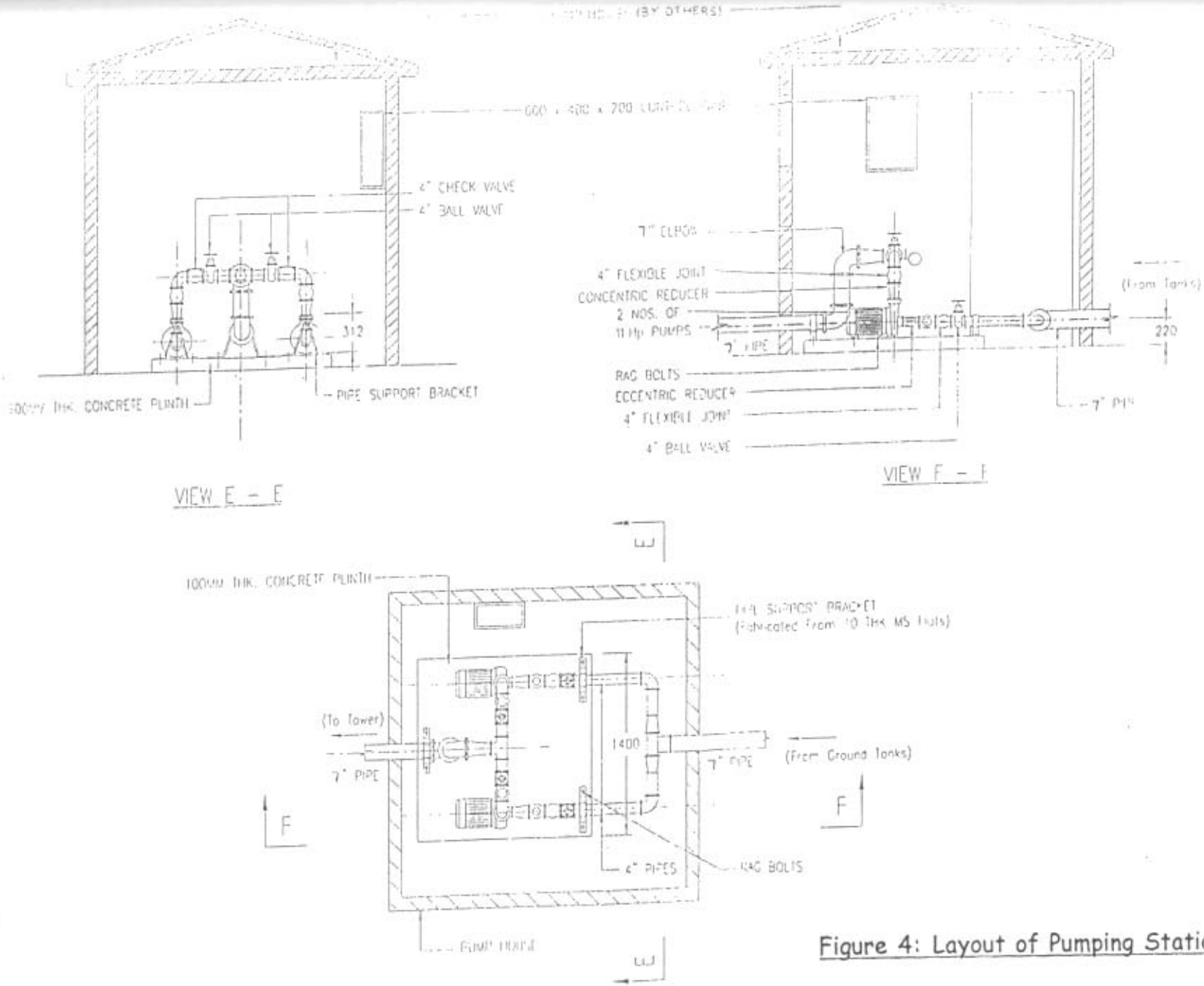

Figure 4: Layout of Pumping Station